Social and Economic Research Project Reports *No. 8*

Acceptability and Use of Monofilament Nylon Filters in a Guineaworm Endemic Area in Western Nigeria: An Intervention Study

Final Report of a project supported by the TDR Social and Economic Research Component

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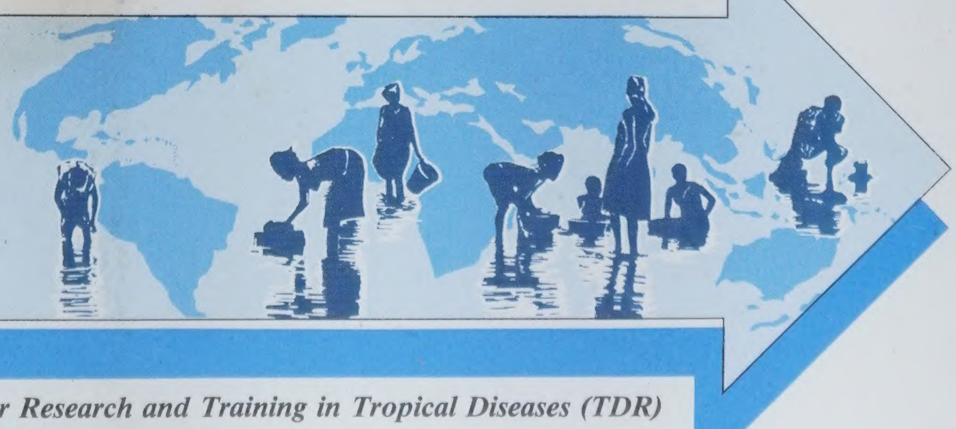
TDR



UNDP/WORLD BANK/WHO Special Programme for Research and Training in Tropical Diseases (TDR)

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TDR/SER/PRS/8

***SER Project Reports** appear as part of a series of unedited final reports resulting from projects supported by the UNDP/WORLD BANK/WHO Special Programme for Research and Training in Tropical Diseases (TDR). These reports are submitted to the TDR Steering Committee on Social and Economic Research for review and evaluation upon completion of a project. Project reports included in this series have not been published in their entirety elsewhere.*

Foreword

The UNDP/WORLD BANK/WHO Special Programme for Research and Training in Tropical Diseases (TDR) is a globally coordinated effort to bring the resources of modern science to bear on the control of major tropical diseases. The Programme has two interdependent objectives:

- To develop new methods of preventing, diagnosing and treating selected tropical diseases, methods that would be applicable, acceptable and affordable by developing countries, require minimal skills or supervision and be readily integrated into the health services of these countries;

- To strengthen -- through training in biomedical and social sciences and through support to institutions -- the capability of developing countries to undertake the research required to develop these new disease control technologies.

Research is conducted on a global basis by multidisciplinary Scientific Working Groups on the six diseases selected for attack: malaria, schistosomiasis, filariasis (including onchocerciasis), the trypanosomiases (both African sleeping sickness and the American form, Chagas disease), the leishmaniases and leprosy. Scientific Working Groups are also active in the "trans-disease" areas of biological control of vectors, epidemiology, and social and economic research. The training and institution strengthening activities are limited to the tropical countries where the diseases are endemic.

The *Social and Economic Research Project Reports* series represents a communication venture undertaken by TDR's Social and Economic Research (SER) Component. This series has been launched to facilitate and increase communication among social scientists and researchers in related disciplines carrying out research on social and economic aspects of tropical diseases and to disseminate social and economic research results to disease control personnel and government officials concerned with improving the effectiveness of tropical disease control.

Research reports published in this series are final reports of projects funded by TDR and usually include more material than ordinarily published in peer review journal articles. TDR considers this material to be valuable both for investigators involved in the study of social and economic aspects of tropical diseases and for professionals involved in training programmes in the social sciences, economics and public health. The series should acquaint those working on similar problems with approaches undertaken by others, in order to test new approaches in different settings, and should provide useful information to personnel in disease control programmes and related agencies.

All requests for further information should be addressed to: Dr C. Vlassoff, Secretary, Steering Committee on Social and Economic Research, TDR, World Health Organization, 1211 Geneva 27, Switzerland.

Tore Godal, Director

Special Programme for Research
and Training in Tropical Diseases
TDR

PREFACE

Since 1979 the Social and Economic Research (SER) component of the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases (TDR) has been supporting research aimed at improving the effectiveness of disease control programmes through the incorporation of social, cultural and economic factors into the design and implementation of control programme activities. In aiming towards this overall final objective, two intermediate objectives guide TDR's social and economic research activities:

- To determine the impact of social, cultural, demographic and economic conditions on disease transmission and control.

- To promote the design and use of cost-effective and acceptable disease control programmes and policies.

The study undertaken by Dr Adeniyi and his team responds directly to the latter objective, in examining the acceptability, cost-effectiveness and sustainability of a filter fabricated by local tailors for guineaworm control in rural Nigeria. Involvement of the community in all aspects of the development and marketing of the filters, including the setting of prices through community participation, was key to their successful use.

Besides to the practical lessons gained from this study, the involvement of medical and other health science students provided training in applied field research. Moreover, the voluntary village health workers who participated in the study benefitted in unanticipated ways because their credibility increased due to the fact that they provided useful products to the community.

In addition to the positive experiences of the intervention the authors frankly discuss the constraints encountered with regard to the sustainability of filter use. These, as well as the conclusions and recommendations of the study, should be kept in mind by others wishing to initiate similar interventions.

Carol Vlassoff, Secretary
Scientific Working Group and Steering Committee
on Social and Economic Research

Special Programme for Research
and Training in Tropical Diseases
TDR

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SUMMARY

Guineaworm disease, otherwise known as dracontiasis or dracunculiasis, is a water-borne helminthic infection. It is endemic in many rural areas of Africa and South Asia where the high rate of morbidity has been responsible for major economic losses due to long periods of incapacitation and sometimes permanent physical disability among the victims.

The adult worm mostly inhabits the subcutaneous extremities of its human host and on contact with water, liberates its larvae, usually when the victim is fetching water from ponds and streams and other surface sources. Within five days the larvae must be picked up by the intermediate host, a water crustecean flea called cyclops, for further development. Man gets infected by drinking raw water containing infected cyclops. The incubation period in man is between 9 to 12 months. Control measures therefore include the protection of water sources from contamination by infected persons and elimination of the cyclops, the intermediate host.

For a long time, the water filter has been one of the popular technologies used in eliminating the cyclops. Filtering of infected drinking water has been found to be relatively cheaper and more feasible on an individual basis than using chemicals to kill cyclops in the water sources or providing alternative cyclops-free sources of water such as protected wells and pipe-borne treated water.

Although filters have been found very useful, particularly in rural communities where populations may be too small and unstable to justify high investment in provision and maintenance of permanent safe water sources, these advantages of the filter are often negated by maintenance problems such as difficulty in keeping it clean and the short life-span of the cloth fabric. The pores are easily blocked with residual sediments in the raw water which makes filtration a very slow process and, as a result of constant washing, the filter gets torn very quickly, thus reducing its effectiveness in removing infected cyclops.

To overcome these problems, Dr K. Steib, while working in Burkina Faso in 1982, designed, tested and showed the superiority of a Monofilament Polyester Nylon Gauze (MPG) water filter over the popular cotton filter. The community of Idere and its 40 farming hamlets in Ibarapa Division of Oyo State in Western Nigeria later served as a focus for an experimental application of Dr. Steib's <u>improved</u> technology. In Idere and its hamlets the MPG filter was tested for its effectiveness in preventing guineaworm and the extent to which maintenance problems peculiar to cotton filters have been reduced.

Previous control methods in Idere had focused on provision of wells as alternative sources for safe water but this had only succeeded in reducing the initial 43% prevalence rate to 27% over a period of four years. But after 12 months of filter intervention activities which included design, marketing and the use of filters over a period of just 6 months covering one peak transmission season, the prevalence rate of guineaworm was further reduced from 27% to less than 10%.

The study demonstrated the overriding benefits, as well as the limitations, of the improved MPG filter in preventing guineaworm from four perspectives - production, cost, distribution and filter effectiveness.

As to production, the use of local materials for sewing and the involvement of local tailors helped not only to reduce costs, but also to gain support and patronage for the filters among the tailors' associations and their customers. Furthermore, the need to subsidize the price became imperative in gaining acceptance at what prospective buyers quoted was lower than the production cost. Experience during distribution showed that in order to assure adequate coverage, attention must be paid to the social, economic and organizational characteristics of the target community.

As to the effectiveness of the MPG filters as a preventive measure against guineaworm at the family and the household level, it was found that lasting results might be difficult to achieve without an in-built operational support system in the target community that will assure regular consultation between consumers and health care providers involved in the disease control activities.

1. ABOUT THE DISEASE

1.1 Earliest Cases

Dracunculiasis or guineaworm is an ancient disease. It was described as the "fiery serpent" that afflicted the recalcitrant Israelites in the Holy Bible (Numbers 21:6). It was known during the Graeco-Roman times[1] and Galen, as far back as circa AD 130 - 200 named it dracunculiasis. A mediaeval Arab Physician, Aviecena (980-1037) described the clinical syndrome in detail for the first time and called the parasite worms "medina worms". Because it was so common in Medina, it earned the name "Dragon of Medina" from which Linnaus in his Systema Naturae published in 1758 bestowed the modern name Dracunculiasis Medinensis.[2] It could thus be inferred that African people gained their first infection from the pilgrim route in Arabia. A European traveller to the coast of West Africa first called the disease guineaworm naming it after the geographical region.[3]

1.2 Mode of Transmission

There is a general agreement on the parasite life cycle. After an incubation period of about 12 months, the adult female worm which can measure up to 80cm in length and a width of 1.5 - 2.0mm migrates to a subcutaneous position of the body extremities, usually a lower leg or foot where it causes a painful blister to appear. When these parts of the body come in contact with water, particularly when the victims enter ponds, step-wells or other such open sources, the water produces a soothing effect on the gravid uterus of the worm causing it to rupture and release thousands of first stage larvae into the water. The larvae which have been found to be active in water for up to 5 days are then swallowed by cyclops, tiny crustaceans or water fleas which are the intermediate hosts. With an optimal temperature of between 25° - 30° and a minimum of 21° centigrade, the larvae moult twice in the cyclops within about 2 weeks, becoming third stage larvae. The infective cylops sink to the bottom of the ponds where they can remain alive for up to 50 days.

In the dry season, cyclops thrive due to the warm temperature of water. Since most water levels are now shallow those fetching the water have to scoop to the bottom to get water and in the process the infected cyclops are picked up. On the average, 5 out of every 1000 cyclops carry third stage larvae. In

the stomach the gastric juices kill the cyclops and liberate the larvae which penetrate the wall of the digestive track and migrate into the abnominal or thoracic cavity where the male and female worms mate at about three months of age. Male worms die afterwards while the females continue to grow for another 6 - 9 months. While growing they migrate to a subcutaneous position in the skin. A blister is formed on the skin and under the blister lies the distended uterus of the worm which ruptures on another contact with water to continue the life cycle. Individual adult female worms could survive in humans up to one year while those that do not appear in the skin die. Dead worms are either absorbed or calcified.

1.3 Treatment

Soon before the worm emerges, some people might experience symptoms such as vomitting, diarrhoea, itching and skin rashes. Strictly there is no treatment for guineaworm. Diagnostic tests are yet to be developed, neither have drugs been found to kill the worms before they emerge. A host of medications which are in use are only reducing the inflamation or easing the extraction of the worms. Extracting the worm usually takes several weeks and this emergence might be accompanied by secondary infection, the most common of which is tetanus when the sores on the skin are contaminated.

Usually, no immunity is conferred by infection with guineaworm; therefore people in endemic areas can be infected year after year and sometimes throughout their lives.

1.4 Distribution

Guineaworm cases have been reported in 22 of the 23 States of Nigeria and an estimated 25 million Nigerians are at risk of being infected every year. About 2.5 million citizens are infected annually out of which 12,000 suffer different types of permanent physical disability.

1.5 Economic and Social Costs of the Disease

It has been established that one sufferer out of every 20 becomes permanently disabled due to muscular disabilities and frozen knee.[4]. Also in one out of 10 patients, the worms have appeared in other parts of the victim's body such as eyes, ears, chest, vertebral column, genitals, womb and bladder. The pain and secondary infections often cripple the victims for weeks or months and some have died of tetanus.

In endemic areas, infection periods usually coincide with farming activities and the effect on agricultural productivity could be substantial. Nwosu _et al_. (1982) reported an average incapacitation period of between 9-14 weeks for 420 victims.[5] Belcher _et al_. (1975) reported an average duration of 100 days.[6,7] de Roy _et al_ (1987) in their study in the rice-producing area of Eastern Nigeria, in which they surveyed 87 households, estimated that 19,854 man-days were lost at a value of US $1.13 per man-day for rice crops alone,[8] Annual per-capita income of farmers in the endemic areas of Idere was estimated at US $152 by Brieger (1990) who also extrapolated an annual loss of US $90,000 for 270 full-time farmers.[9] Based on annual per-capita income of US $125 in this area, the loss per victim is three times the average yearly income of the study population. Probably because of the recurrent yearly and unresolvable damage to the health of the people, a 'coping' attitude has been developed to the extent that the seriousness of the disease has become under-estimated. This was well reflected by Nwosu and his colleagues in their study in Anambra State of Nigeria between 1978 and 1979 which showed that out of 3,641 cases examined, only 1983 or 5% had visited the hospital or health centre prior to contact with their team.

1.6 Preventive Measures

In Nigeria, about 99,000 communities have no access to safe drinkable water. Improving this situation would require investment of above 2.5 billion dollars which the economy cannot support. The Federal Government with support from international organizations such as International Water and Sanitation Decade, WASH and more recently, Global 2000, has since 1988 targeted the disease for eradication.[10] To this end efforts have been concentrated on the provision of safe water in rural communities on a permanent basis, while other short-term measures which are cheaper, effective, and practicable are also being emphasized. These include preventing the victims from entering drinking water sources and persuading those at risk to boil or filter their drinking water.

But while the construction of safe drinking water sources is by far the most reliable preventive measure, it has been realized that this, by itself, cannot be sufficient unless the improved water sources are properly maintained and the affected communities use them regularly. In addition to superstitious beliefs, villagers have always adduced other reasons such as convenience, cost, taste, etc, to justify their continued use and preference of the existing contaminated sources to the newly provided protected sources. Therefore, in many control programmes efforts are directed towards health education for changing wrong knowledge, attitudes and beliefs and the resultant practices.

2. BACKGROUND TO THE STUDY

2.1 Guineaworm in Idere: a Historical Sketch

The main town of Idere was settled over one hundred years ago by citizens of the Old Oyo Empire. The town is located in a 'cul-de-sac" of granite islebergs. These rocky out-croppings of granite cover most of what could have been farmland for the predominant farming population who number about 2,000 out of the 10,000, are scattered over a radius of 30 kilometres around Idere and residing in about 40 hamlets. Most have poor access to the few health facilities which are located in Idere and the larger neighbouring towns of Igboora, Tapa, Igangan and Eruwa.

Piped water was provided in Idere and three other towns in the district (Igboora,Eruwa and Lanlate) in 1967 from a reservoir located 35 kilometres away, and three years later in 1970 guineaworm, which had been highly prevalent in the area, was virtually eradicated. But in 1977 after only 10 years of operation the system began to fail, and by the end of 1980 piped water was reaching Idere only once or twice a month and even the supply was limited to a third of the town's population on the eastern side. (Figure 1)

The loss of the piped water forced people back to the numerous ponds and pot-holes that lined the southern edge of the town which used to be the focus of guineaworm transmission. All along the residents of the hamlets who had never enjoyed piped water served as a reservoir of infection and during their frequent visits to the town subsequently transmitted the disease back through the old Idere water sources. By 1980, the prevalence rate of guineaworm had again exceeded 40%.

2.2 Past Efforts of Guineaworm Control in Idere

Since 1963, the Department of Preventive and Social Medicine (PSM) at the University of Ibadan has been using the State Government Rural Health Centre at Igboora (17 kms from Idere) as a base around which a teaching and research training programme for medical and other health science students was operated by the academic staff. Activities of the staff and students related to guineaworm control prior to the provision of pipe-borne water in Idere included the construction of some demonstration wells in outlying villages, epidemiological surveys and drugs trials research on the treatment of the disease.[11]

Involvement and participation of the communities in control measures was not formally organized until 1978 when a Master of Public Health (M.P.H) student and some staff of the African Regional Health Education Centre which was established as a unit of PSM began a pilot primary health care programme for Idere's satellite farm hamlets with a major goal of controlling guineaworm.[12] Volunteer Village Health Workers (VHWs) from 10 hamlets received training from the MPH student on personal protection measures and they worked together to reduce the prevalence rates which ranged from 50 - 70% to an average of 5% over a period of 2 years in the 10 hamlets. The situation in the remaining 30 hamlets, however, remained unchanged.

In the town of Idere, initial activities focused on the construction of family wells as alternative sources of water. The number of family wells increased from only 6 in 1978 to 19 in 1985 through research activities in an earlier project which was also supported by TDR/SER[13]. But even with this increase, less than half the town residents had access to a family well and most of the available ones were not productive for several months in the dry season. The dry season is the peak transmission period for guineaworm and when most of the wells dried up people had to resort to fetching water from infected ponds and water holes.

2.3 Experiences with the Filter in Guineaworm Control

The use of the filter in the control of guineaworm in Idere had been justified from two angles - economic and geological. The subsistence farmers of Idere realized too little money from the sale of their crops (mainly maize, cassava, melon seed and tomatoes) to be able to afford the high cost of cement and other materials needed for well construction. Secondly, the geological problems of rocks and a predominately sandy or clay soil posed engineering problems to the traditional hand-dug wells in Idere. After what must be considered to be a relatively high investment these wells always sank or collapsed after less than 2 years of service and the situation had discouraged many new and potential adopters. Therefore many Idere residents had used cotton filters in the past because it was a cheaper alternative to other control measures.[14] Most of these users had complained that cotton filters were inconvenient to use because they were not durable and difficult to clean. Although the unit price was always affordable, filters were deemed expensive because they had to be replaced from time to time. For these reasons the effectiveness of cloth filters in reducing incidence of guineaworm in Idere had always been temporary.

2.4 Improvement in Filter Technology

Maintenance and durability problems in the use of the cotton filters have been reported in other areas where the filter has been used as a control

measure. Prompted by the technical and operational shortcomings of cotton filters, Dr K. Steib from Heidelberg Institute of Tropical Hygiene and Public Health, Germany, in 1983 carried out research in a guineaworm endemic area of Burkina Faso (Upper Volta) with two main objectives:

(1) To obtain a filter material that would be durable, easy to clean and at the same time affordable to the majority of the infected population.

(2) To design a filter with an appropriate mesh size that would effectively filter out all active and potential cyclopoid species which might contain infective larvae of Dracunculus Medinensis from water obtained from infected sources.

Subsequently, Dr Steib[15] designed a Monofilament Nylon Polyester Gauze (MPG) filter which was found to be, on the local market, far superior to the popular cloth filter. This special material, with a mesh size of 100 microns, prevents the passage of even the smallest cyclops larvae which carry the guineaworm, yet it does not clog up with silt and colloidal salt suspensions from the local pond water; it is easily washed by rinsing; it is light but highly durable; and it preserves the taste of the water which the farmers like".

With a frame of pliable bark from a local tree, and some small nails, a 25 cm square of gauze was fitted by local craftsmen to form a circular sieve; or, stitched onto an Indian rubber band, the gauze filter was tailored to fit over the mouth of any gourd, calabash or earthenware pot widely used in the research area. Thus guineaworm filteration out of the farmer's drinking water was assured rapidly, effectively and at little cost. For the manufacture of the filter, including the nylon gauze which came from France or Germany, the cost was worked out at about US 80 cents per sieve.

2.5 Adaption of Dr Steib's MPG Filter for Use in Idere

The principal investigator in this research became aware of Dr. Steib's activities in Burkina Faso through discussions with the secretary to the TDR/SER, Dr. Patricia Rosenfield, in 1984. Subsequently TDR/SER made funds available to Dr Steib to visit Idere with samples of his MPG filter. During his stay, he assisted the Idere research team in carrying out a biological examination of the cyclopoid species in Idere water sources and it was shown that they were similar to the ones in Burkina Faso. With the assistance of TDR/SER the MPG filter fabrics were imported from West Germany. Preliminary studies were also funded to determine the affordable prices of filters, the sizes that fit the local containers, the educational component for the sales promotion and a marketing strategy for filter distribution. The recruitment and training of local tailors and the use of traditional materials (threads and rubber bands) to sew the filters were also to be explored as well as the extent and nature of involvement of community members such as Community Volunteers and Village Health Workers.

3. THE BASELINE STUDY

3.1 Objectives of The Study

The Monofilament Nylon Cloth Filters were thus conceived as a timely and appropriate intervention for the control of guineaworm in Idere and its hamlets.

The study objectives were therefore to:

(1) conduct an epidemiological survey of the infection rate and types of cyclops in Idere water sources with the view to determining the seasonal variations in transmission and the period for optimal filter use;

(2) collect information on types and sizes of materials used in collecting, transporting and storing water by residents which could be used in designing appropriate filters;

(3) produce suitable filters using local resources and initiatives;

(4) market the filters and monitor the adoption process including pricing, purchasing, maintenance and durability of the filter;

(5) assess the impact of filter use on the prevalence and incidence of guineaworm over a 1-year period.

3.2 Monitoring Activities*

The first year of the study was devoted mainly to the baseline survey and covered objectives 1-2, while the second year intervention period covered objectives 3-5 which included the intervention, monitoring activities and evaluation which were designed as follows:

3.2.1 Record Keeping

During the production, records were kept by research staff of all meetings with VHWs, and regular observations on production were made in the tailors workshop. Records were kept on amounts of materials used, production time and techniques employed.

The main objective of this approach was to learn as much as possible about local capabilities in manufacturing the new technology.

3.2.2 Monitoring of Field Activities

The performance of sales persons was monitored through participant observation. The VHWs reported their sales and promotional activities at the regular meetings of their association. During such meetings, new stock was distributed and sales accounted for. In addition, local research assistants visited each family at least once every month a sample of households to gather information on number and types of filters purchased, reasons for purchases, date of purchase, filter use practices and any comments or complaints about the filter from households members.

3.2.3 Material Quality Assurance and Control

The monitoring of the maintenance of the filters started from the end of the first month after the first purchases and continued for the next six months. All filters which had been sold or which were in use for a minimum of one to a maximum of 6 months (depending on when the filter was purchased) were inspected on a regular basis. A one=time inspection of filters occurred six months after the first exercise.

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* See also Chart 1

3.3 Survey Instrument

Since the use of cloth filters to control guineaworm had predated the MPG filter project in the research area by several years, the baseline survey was undertaken to know about the past experiences of the community in the use of cloth filters, especially their perceived notions of filter effectiveness as a control measure and their attitude to a re-introduction of new filters. Therefore, people were asked if they would be willing to purchase improved filters and how much they would be willing to pay. Observations were made in households and measurements taken of all types of family water receptacles. Opinions were sought on filter design, production techniques and the marketing strategies. The enquiry focused on the household unit (consisting of husband, wife\wives, children and other dependants) but women supplied most of the information. This is because according to the traditional culture in the area, women were supposed to have the responsibility for collecting, transporting and storing water for household use.

3.4 Sampling

In the hamlets, each of the 40 hamlets constituted a sampling unit and in town, the family compound. The sampling units were stratified based on the presence of a volunteer primary health worker (VHW) in a unit. At the time of the baseline survey (August 1984), 18 of the 75 family compounds in town and 25 of the 40 farm outlets had at least one primary health care worker each. Six compounds with PHC workers and an equal number without were randomly selected in the main town, three from each of the two traditional sections. The total number of households in the hamlets was 410, while that of the Idere sample was 317. A total of 250 respondents were interviewed in the hamlets; out of these, 196 were from hamlets which had a VHW and 54 from those that did not. In Idere town, there were 121 respondents, of which 67 were from compounds with a VHW and 54 from those without.

Interviewers consisted of two respondents of nearby Igbo-Ora who had served as research assistants in the Idere research activities before, plus two National Youth Service Corps members who were attached to the Ibarapa programme. They were trained by the research personnel and they jointly translated the questionnaire into the "Yoruba language" since most of the respondents were expected to be illiterates.

3.5 Findings

3.5.1 Ever Heard about Water Filters

Of the 371 persons interviewed, 56% had heard of filtering as a water treatment method. Table 1 shows that 64% of respondents living in farm hamlets with VHWs had heard of filtering, whereas only 26% of those living in other hamlets without VHWs had heard, a difference which was statistically significant. Among respondents in the town there was no significant difference ($P>.020$) between compounds with VHWs and those without VHWs.

3.5.2 Ever Used Conventional Filters

Overall, only 10% of respondents reported actual use of conventional filters, 10% in the hamlets and 11% in town. No one in a hamlet without a VHW ever filtered drinking water. Again in town there was no statistically significant difference between VHW compounds and non-VHW compounds, contrary to the hamlets where the difference was significant (Table 2).

3.5.3 Water Treatment Practices

Overall, 57% of the respondents said they treated their water with alum while 11% boiled water in addition to about 10% who filtered. The most common reason for using alum was to help the water settle (50%), but many other people thought it could remove germs or dirt and prevent guineaworm or other water-borne diseases. Filtering of water before drinking was known to prevent guineaworm by 40% of filter users but some also thought filters could remove germs and prevent diseases in general. Out of those who boiled their water 40% thought it could remove or kill germs while 38% thought it could prevent guineawom (Table 5).

3.5.4 How Much Willing to Pay for a Filter

Respondents were shown a sample of the monofilament nylon filters. In giving their opinions on what they would be willing to pay, 60% gave a specific amount, 11% said they would pay any amount, 18% did not give a price for the filter and 2.2% said they were not willing to buy a filter. The quotations for acceptable price ranged from #0.50 to #5,00, (U$1.50 =#1.00) at the time of the study).

There were no major observable differences in price quotations between hamlets and town respondents (means of #3.08 and #3.12 respectively). While the upper limit of quotations was about #10.00 in both cases, the lower limit in the hamlets was lower (#0.50) than in town (#1.00). It should, however be noted that more hamlet residents (69%) than town dwellers (42%) quoted a price while the number willing to pay "any amount" was higher in the town (32%) than in the hamlets (13%).

3.5.5 Who is Willing To Pay 'More' for a Filter

Farming was the most common occupation in the hamlets (69%) while trading predominated in town (79%). When the price quotations were categorized by occupations, farmers were willing to pay an average of #2.87 for a filter, compared with #3.34 for traders and other occupations. The few male respondents were willing to pay more than females for a filter (means of #3.85 and #2.99 respectively). The corresponding median quotations were also #2.75 for men and #2.00 for women while the lowest quotations were #1.00 for men and #0.50 for women.

3.5.6 Water Containers in Use

Containers used for fetching and storing water were counted and measured in all respondents' households. The 371 households owned 564 containers, mainly clay pots (an average of 1.5 per household). Their widths ranged from 10 to 24 inches.

3.6 Filter Maintenance

In addition to the information collected on the design, production, pricing and marketing of the filter, the research staff saw the need to run tests on proto-type filters in situations simulating real life usage. This was to ensure that the chosen designs were appropriate and that assumed technical improvements in the filter were valid. Running of tests also helped to develop a health education package on the use of filters which accompanied sales, whereby buyers received information on the appropriate way of using the filter and how to maintain it.

A student undertook the testing of filter cloth as one of his major tasks. After collecting cyclops from local ponds, he tested their survival rates within the filter cloth under various conditions which included:

(a) Washing the cloth after use.
(b) Not washing the cloth.
(c) Drying the cloth in the sun.
(d) Hanging the cloth in a moist place after use.
(e) Folding the cloth and storing it directly after use.

The results showed that cyclops could survive in a wet filter for up to 12 hours. The conditions which fostered cyclops survival were hanging the filter inside the house, especially when it was folded or leaving it crumbled up on the floor or in a container. Filters dried quickly in the sun thereby killing the retained cyclops. One student found that many people collected their water in the evening and hung the filters where dew could keep them moist. Also he saw the need to be able to distinguish a top and bottom side of the filter so that surviving cyclops would not be washed into the drinking water if the filter was ok re-used with the reverse side. This also showed the desirability of washing the filter after each use if possible. The resultant educational package is shown in Chart 1, "Steps for Safe and Effective Filter Use."

4 INTERVENTION PROCESSES

4.1 Filter Design And Production

The first task was how to incorporate the results of the baseline study into the filter design and production phase. Of particular concern was filter size. The most common sizes of the 564 pots measured during the baseline survey were 14 inches (13%), 15 inches (32%), 16 inches (28%) and 17 inches (14%). Smaller pots accounted for 7% while 6% were larger. With this information it was decided to make filters in three sizes: small (less than 13 inches in diameter). medium (13-16 inches) and large (17 inches or more). It was estimated that the medium filters would be in greatest demand (approximately 70-75%), followed by large (20%) and small (5%).

Upon examining the cloth the researchers felt that four <u>medium</u> filters could conveniently be cut from a square metre. The width of a <u>large</u> filter could conveniently be cut from a square metre and after this the remaining strip could be used to make <u>small</u> filters. A full one hundred metres would make 400 medium, or approximately 150 large plus 250 small, filters. Considering the low demand for small filters, not all the cloth remaining from making large filters might be needed and discussions were held on how to avoid wastage.

The key element in the design was a rubber band, actually strips of old inner tubes commonly sold in the local market for sling shots. These sold for #0.50 each, but could be purchased more cheaply in bulk. Cloth was cut in circles and the rubber band was sewn into the edge\hem. This was not only cheaper than using a wooden frame, but also fit more securely on the pot so that unfiltered water could not spill in by mistake. The VHWs were impressed with the design.

The Idere VHWs were involved in all decisions on filter design and production. Next, after deciding on sizes and quantity, was the issue of who would manufacture the filters. Incidentally, one VHW was also the Chairman of the Idere Young Tailors Association. The VHWs naturally requested that he be responsible for arranging a group of tailors to commence local production.

Besides himself who would serve as supervisor, the VHW tailor selected three other local tailors, two men and one woman. They all agreed to pool their sewing machines at the woman's workshop which became the filter factory for the next month.

After negotiations between tailors, research staff and VHWs, an agreement was reached to pay #0.40 per filter sewn. This would include the cost of the thread. The tailors' advice was sought on various production details. They also indicated that it would be possible to use threads of two different colour when sewing, so that a top side could be distinguished from a bottom as suggested in the baseline study. In this case,the most readily available colours were black and white; the former was chosen to appear on top.

Local tailors used their own initiatives to develop production methods. First, they tried sewing the hem of the circles of cloth, then inserting the rubber-bands, just as they do when making draw strings (belts) for local trousers and skirts. Pulling rubber against the nylon was found to be quite difficult, so they began sewing the band directly into the hem of the filter. They also discovered that by setting their machines on zig-zag stitch, the product would be stronger than if straight stitch were used.

First, eight samples were made and tested at VHW homes and this led to further improvements. The research team and VHWs came to observe production regularly and check for quality. An important quality concern was the width of the rubber band. Since these had been hand-cut, the sizes varied and some were found with narrow weak places that would snap if stretched. Approximately 10% of bands were screened out because of this weakness.

The tailors themselves did the measuring, cutting and sewing while their apprentices tightened the rubber bands on the finished product and sorted them by size. The time to complete the sewing of one filter was about fifteen minutes.

Although the baseline survey from the previous TDR project (which had trained the VHWs) found nearly 2000 family units in Idere and there was sufficient MPG material for making one litre per family, the initial production was not aimed at total coverage. There was need to wait for actual demand, although the initial survey showed that this could be up to 50% of family units. Therefore a basic stock of 800 medium, 150 large and 200 small filters were produced in the first month. The tailors did not have to drop other works to fit the filter production into their regular operations. Two hundred more large filters were produced at a later date.

While production was underway the VHWs were receiving training on the steps involved in safe and effective filter use. These would form the basis of the VHWs' educational task that accompanied filter sales. The ten steps are listed in Chart 2.

4.2 Price Setting

In the commercial sense marketing is said to contribute 50% to the value of a product. While social marketing also adds value to a good service or idea by increasing its accessibility to consumers, the achievement of the social goals must take into consideration the maximum amount of marketing cost that could be passed on to consumers. The results of the baseline survey which showed that 75% of respondents would pay at least #2.00 per filter was crucial information in price setting which had to be matched against production costs.

The basic input costs of one filter were as follows:

Rubber bands: bulk cost of #0.18 per band which included a small wastage factor as not all bands were cut uniformly and bad ones had to be discarded.

Sewing: cost of #0,40 for sewing one filter which included the supply of thread.

Filter cloth: about #0.60 for small, #0.75 for medium and #1.90 for large.

The TDR Steering Committee had stressed the need to set a reasonable price so that people's willingness to acquire filters could be tested without inhibiting acquisition. Therefore, distribution and sales costs were dropped and in the spirit of social marketing, the sponsoring agency was assumed to be bearing the brunt of marketing costs. The basic costs were then calculated at #1.25 for small filters, #1.50 for medium and #2.50 for large.

It was envisioned that VHWs would be more involved in sales because of their past experience and knowledge in guineaworm control and, as an incentive, a small amount would be added to the basic cost of filters and retained by sales persons. Other salespeople included local market women and other volunteer community members. The issue of a fair return to these other volunteer salespeople was brought to them for deliberation. These other sales persons were initially asking for a profit margin higher than what VHWs had approved for themselves but the VHWs were very keen that the project did not turn into a money-making exercise and wanted the majority of townspeople to be able to purchase the filters. The VHWs felt that wide price differences (for the same size filter) between them and the other salespeople could generate ill feelings in the community and this would not be in the interest of the programme. Therefore,they persuaded the other salespeople and unanimously agreed that profit should be fixed at #0.20 per filter for themselves and the other sales persons.

4.3 Distribution Arrangements

As mentioned, the Idere community consisted of two distinct sectors: the main town of Idere and the 40 farm hamlets, grouped into two main clusters. One hamlet group, located northeast of town, had easy access to Idere either by foot or vehicle, the farthest hamlet being only 12 kilometres away. The other cluster was west of town across the Ofiki river. From May to December when the river could not be crossed the only access to this sector was a bridge located 25 kilometres north Idere. The need to extend coverage to all three areas was considered. Most of the active VHWs were in the main town and the Northeast cluster of villages. Therefore, it was expected that VHWs would form the core of sales persons in these areas while other persons would distribute the filters in the Western sector hamlets.

Considering the relative size of the main town and the underserved nature of the western sector of villages, efforts were made to recruit other sellers. This addition had its own advantages in that it would make it possible to compare the performance of local business people with the Volunteer VHWs.

The remaining salesforce consisted of 35 individuals of whom 27 were VHWs. Six of the others were Idere-based volunteers (including four women who sold provisions in the local markets and two men, a shoemaker and a farmer/preacher). The other salesman was the project's field assistant who

covered those villages which had no easy access to any salesperson. Arrangements were made for easy stocking and re-stocking. One of the VHWs volunteered to keep supplies in her home for others while the health team always collected filters during the fortnightly VHWs's meeting. It was also during this meeting that VHWs would submit their receipts. The field assistant was responsible for collecting sales proceeds from non-VHW salespersons and the VHWs who could not attend the meetings.

4.4 Sales Promotion and Marketing

Each of the 35 salespersons received training before being given an initial stock of 12 filters. The purpose of the sales and how to use the filters correctly were explained and demonstrated. Each salesperson was reminded that health education was his/her major task and that it should be stressed to every purchaser that if the filter was not used regularly and correctly, guineaworm would not be prevented and they might be dissatisfied with the product. In particular, salespeople were to inform purchasers about the interval between ingestion of water and the time the worm appears (about 12 months) so that some customers might already have been infected with the disease before using the filter. Therefore, the full benefits of the filter might not be seen for a year or more and this would depend on constant and correct use of the filters.

The responsibility for promoting community awareness and encouraging sales was given to the VHWs' Association. They called village and compound meetings where the filters were demonstrated. They also made house-to-house visits to exhibit the product. At the VHWs meeting members were designated to make announcements at the local churches and mosques. Some VHW leaders visited the king of Idere to explain the project. He agreed to have his town criers make the announcements about the filters.

The field assistant made monthly visits to villages and compounds to document and monitor use. He used these visits also to promote sales, reinforce education about regular and correct use of filters, supervise VHWs and assist them in solving problems encountered during sales promotion activities. Medical and health education student field interns were also involved in house-to-house inspections to find out who had the filters. They sometimes asked residents to demonstrate the correct use of filters. The students also explained the value of filters to families which had not yet bought them.

During the meetings between the VHWs and the research team a marketing strategy was worked out which described a stepwise approach to marketing and a model sales talk as follows:

(i) Marketing of the filters will be by the Face-to-Face method of direct sales. During the individual one-to-one sales the salesperson will make use of a model sales talk.

(ii) The sales talk will touch on prevalence of the disease, the economic and social costs and failures of past efforts to tackle the disease with special reference to cloth filters. It will also explain that filter is a relatively cheaper and effective preventive method if properly used, that the present filter is stronger and washable, that it is being sold at a subsidized price and that users will be assisted to use the filters correctly.

(iii) The sales talk will be supported with appropriate posters, films, local songs and proverbs on the dangers of guineaworm and the need to prevent it.

(iv) The correct way to use the filters will be demonstrated to the individual purchasers and groups in compounds, mosques, churches, market places, etc.

(v) Every buyer will be informed that the filters were being sold at a subsidized price made possible by the WHO\TDR\SER as part of further contribution towards Health for All by the year 2000. Therefore members of the WHO\TDR\SER research team will be visiting the villages periodically to see that filters are used regularly and correctly and to attend to problems they may have in the use of filters.

4.5 Monitoring of Sales, Distribution and Usage

The participant observation technique was used to learn how the salespeople functioned and how consumers used their filters. This involved attending regular primary health worker meetings which also served as the major channel for distributing filters and collecting receipts.

Once sales began in October 1985 a system of monthly monitoring at the household level was developed. A local research assistant visited each family in selected areas to gather information on guineaworm prevalence, types and numbers of filters purchased, reasons for purchases, date of purchase and filter use practice. This monitoring was done in 36 farm hamlets and 30 compounds in Idere town. The hamlets consisted of 14 where the resident village health worker had filters for sale while 22 were those without VHWs. The 30 compounds were divided equally, 15 were those with a resident salesperson (VHW or community member) and 15 were without.

This monitoring period extended through the dry season until the end of March 1986. Depending on the time the filter was purchased, the condition could be observed from a minimum of one to a maximum of six months use. In October 1986 a follow-up survey was done in 13 hamlets in the northeast cluster to determine continued use and durability. This was conducted with the assistance of medical students undergoing their rotation in the Ibarapa rural posting.

5. FINDINGS

5.1 Sales Promotion

The project staff deliberately commenced filter sales in October, just before the beginning of the dry season so that filters could be in use during the period of maximum guineaworm transmission (October to December).

The areas selected for monitoring the adoption and use of filters included 779 households, an estimated 40% of all family units. This included 388 families in the hamlets, that is 60% of all farm families and 391 in the township or approximately 30% of town households. By the end of the first six months of surveillance 33% of these family units had acquired filters. This coverage of nearly one third of the population marks a 200% increase over the reported use of filters in the baseline survey. Table 3 breaks down filter sales by sector. The town recorded the lowest coverage (21%) while the Tobalogbo group of hamlets ranked highest (57%)

Several factors could have accounted for these differences in sales. Of the 16 hamlets in the Tobalogbo area, 13 had VHWs, of whom ten sold filters. This area had the highest concentration of sales people in the three sectors. People living on the other side of town across the River Ofiki had the lowest number of salespeople (four). Besides this, the area was cut off by River Ofiki during the early months of sales as it was inaccessible because of heavy rainfall. The sales occurred only during the monthly visits by the research assistants who travelled in a landrover by means of the longer route involving crossing the only bridge located several kilometres away. Although the number of salespeople in town was the same as those in the villages, the coverage in the hamlets was better because the town had about four times the total population in the hamlets.

A total of 407 filters were sold between October 1985 and March 1986. Out of this number, 254 filters were seen in the areas monitored by the research team. The proportion of types (sizes) of filters sold was quite different from what was originally planned (Table 4). The number of large filters was underestimated due to an error in measurement. The amount of cloth required to form the hem for the rubber band took more material than had been calculated. No allowance was made for this difference with the result that many of the medium filters which were too small and the large filters were found to be appropriate thus increasing the number of large filters purchased. This led to wastage of materials because the left-over from a large filters could only make a small one and already the estimate for small filters was only one-third of the large size.

Of the three types of salespeople involved, VHWs accounted for most of the sales (74%). Other sellers (market women, tradesmen, etc.), while constituting 20% of the sales force, sold only 5.4% of the filters.

Performance of sales people varied by sector. While VHWs were responsible for the vast majority of sales in Tobalogbo and the town, the research staff made more sales in the Oke Ofiki area. Other sales people made negligible sales (1.6%) in all monitored areas. The presence of VHW in a compound or hamlet, especially when he/she had regular supply of filters was associated with sales performance and coverage.

Figure 2 and 3 show the sales/adoption curves for the monitored areas. Overall, acquisition rose sharply in the beginning and peaked in November 1985, then trailed off into March 1986, the last month filter sales were promoted. About 75% of sales occurred in the first three months. Thus it can be concluded that those who bought filters made up their minds relatively soon (within the first two months) while most of the late adopters waited until the very end of the dry season. It would be unlikely that another rise in sales would have occurred had the promotional activities continued beyond March because the rains would have started to provide alternative sources of cyclops-free water in the wells and streams.

Sales also got off to an early start in the Tobalogbo sector and in town. In Tobalogbo the bulk of sales (80%) occurred in the first two months. As mentioned earlier, this area had a high concentration of VHWs who embraced the project enthusiastically. It was one VHW from this area who won the price for making the highest number of sales (37 filters). This contrasts with the slow take off across the River Ofiki. Resident sales people were few and for the first few months residents had to purchase filters during their occasional trips to town. It was not until the research assistants began to sell filters in this area in December that sales peaked.

5.2 Characteristics of the Consumers: Purchasers and Non-Purchasers

Those who purchased filters were primarily male (75%) and mostly in the 40-54 year age range, while female buyers were younger (35-49 years). This difference in the age between the sexes could be attributed to the fact that women marry earlier than men.

Tables 5 and 6 show other factors that could have influenced purchases. The VHWs who sold filters were predominantly men and most of their customers were men, especially in the Tobalogbo sector while in the town equal number of men and women purchased filters. Men who bought filters also did so at an earlier date than women. Persons who purchased at a later date were more likely to know a friend or relative who had a filter at the time of purchase. Only 16% of the early adopters knew another filter owner as compared to 44% of late adopters. But ironically slightly over half of non-purchasers knew a friend or relative with a filter by the end of the monitoring period.

The influence of a "significant other" who had bought a filter was demonstrated in the farm hamlet called "Thank You". When the monitoring team visited the hamlet in January 1986 no one in the seven households owned a filter. But after this visit one influential woman in the hamlet decided to buy a filter when she was visiting relatives in Idere. When the monitoring team returned to the hamlet the next month, everyone in "Thank You" wanted to buy a filter. An opposite experience was, however, recorded in 'Sangote' hamlet where one woman who had a filter tried to persuade other women about the benefits but one else bought a filter. The research assistant later learned that this woman had always done her domestic chores differently to show that she was more enlightened and this was interpreted as arrogance. Therefore no woman would want to identify with her as a filter innovator.

There was no significant difference in the percentage of Moslems and Christians who purchased filters (30% and 36% respectively), but those who claimed to be traditionalists were not interested in the filters at all, and only 5% of them purchased them.

The effect of recent history of guineaworm in the family on purchases was also examined. Contrary to expectation Table 7 shows that a greater proportion of families who had no cases of guineaworm in the past two years (36%) bought filters as opposed to 26% of families who had the disease. Similarly, Tables 8 and 9 reveal that significantly more of the people with access to wells bought filters than those without in both the town and villages were 83.3% and 42.0% respectively.

Table 10 shows the relationship between source of information about filters and purchases. The VHW was the major source of information. Families who claimed this source had the highest sale of purchase compared with the other sources. Overall, interpersonal information through salespeople and research staff was more reported and claimed to be more effective than general announcements made at churches and mosques. Other promotional channels that were used, such as demonstrations in the market places and information passed through the traditional chiefs, were not mentioned.

As to non-purchasers, out of the 525 families who did not buy a filter 92% knew it was being sold to prevent guineaworm. The popular reasons for not buying filters given by 82% were financial inability. Although 37% or 192 of the non-purchasers had access to well water, only 12 of them gave this as a reason for not buying a filter. A few (4%) said they had a filter elsewhere.

5.3 Filter Use and Maintenance

5.3.1 Monitoring of Sales

Filter use education was part of sales promotion and confirmation was sought on the first visit by the research assistant from the consumer who had purchased a filter (Table 11). The table shows that salespeople took their educational job seriously. Purchasers even reported that VHWs went as far as calling village gatherings to demonstrate and explain the correct use of the filters. Most purchasers remembered six points relating to correct usage of filters: "black thread upwards", "pour water slowly", "let all water go out", "shake out after use", "wash after use" and "hang outside to dry." They did very poorly on two points relating to maintenance and filter effectiveness: "avoid sharp objects during storage "and" inspect filters before each use."

The research assistant faced a major problem of not finding people at home after repeated visits. The Idere community moves freely between the town, its hamlets and neighbouring Ibarapa settlements. This has major implications for disease transmission, especially as consumers admitted that they left their filters behind during such visits. Some villages who took their filters during visits to families in town said they forgot to bring them back.

Regardless of length of ownership or use it was observed that about a third of the owners left their filters in the open where they could be damaged by sharp objects, while up to one-fifth of filters were found stained, indicating unhygienic handling. Finally over 10% of the owners placed the filters wrongly upside down when asked to demonstrate how they used them. The only product defect observed during the monitoring process was breaking of the rubber band. This happened almost at any time, but the total number was relatively small, 3% of total filters in use for at least one month (N=254). When a broken rubber band was discovered by the research assistant, he replaced the whole filter free of charge. It should be noted that attempts were made to minimize this problem during filter production.

Filtered water was used mainly for drinking (90-100%) followed by cooking and washing of plates. About half the families had one main water storage pot which was used for all purposes.

No negative comments were recorded on filter use (Table 12). Users consistently affirmed that the filters removed impurities, leaves and insects from water. Other comments were that the filter is fast, easy to use and more convenient than boiling.

5.3.2 Post-intervention Study: After formal monitoring had ceased in the area, each hamlet was visited by Ibarapa programme staff, at least two times in the interim as part of the regular supervision of VHWs activities. A follow-up study of filter owners in October 1986 provided a picture of use seven months after the last formal monitoring visit and one year after filter sales began. The survey was confined to 13 hamlets in the Tobalogbo sector which were accessible and had a high concentration of filter owners. The scope of the survey was limited, as medical students from the Ibarapa programme were involved in collecting the data as part of their normal epidemiological studies and had limited time to carry out the work.

Eighty-eight families who had filters in the 13 hamlets 65 were found at home and interviewed. Most of the families (82%) were still using their filters. The most common reasons for stopping were filter defect such as

loose or broken rubber bands or holes. The issue of the band becoming loose had been reported during the monitoring phase by the research assistant. At that time, he routinely tested each band for elasticity and would tighten or replace those that were found to be loose. It is significant that 5% of filter users who abandoned their filters since monitoring stopped gave this reason. The post intervention study also shared a slight decrease in knowledge (99% to 83%) on the correct use of the filters in relation to the sides marked with white and black threads compared with the study. But apart from another slight decrease in knowledge relating to storage for safe keeping, other steps were remembered at least as well as before. Although all respondents claimed that they washed their filters, one quarter did not do this after each use (Table 13).

While only three persons reported that they had stopped using their filters because of holes and tears, Table 14 shows that in fact many of the other filters in use had holes. Most holes and tears were in the peripheral part of the filter and some had diameters as long as 5 cm. Many of the filters in use had a problem of loose rubber, coupled with frail edges and broken stitches, which could result in poor fitting and spillage of unfiltered water with cyclops into the pots. There was actually 32 torn/damaged filters (59% among those still in use). Five persons presently using filters, four of which had holes, said they would be interested in buying a new filter.

Most of the filters had turned brown or greyish. Water in Idere normally turns muddy in the dry season and this could have accounted for the brown discolouration; the colouring on the other hand could also have resulted from hanging the filter open inside the house where soot from the cooking fire could have become embedded, a pointer that such filters were not being used regularly. This way it was possible to cross-check the reported use of filters by owners. Based on these reports and observations, it was estimated that 66% of owners were unprotected from guineaworm at the 1986/87 dry season or six months after the intervention phase. Since most of the Tobalogbo filters were bought in October and November 1985, the durability of filters was estimated at 10-12 months, meaning that the monofilament nylon filter could not be counted on to last through two transmission seasons.

With respect to user variables that might have influenced the damage seen in the cloth, no difference was found as to whether owners stored their filters in a plastic bag, as recommended by the field assistant, hung them in open places, or kept them with other household utensils in household baskets or pots (Table 15). However, frequency of use was found to be an important factor (Table 16). Most (80%) of filters which were reportedly used four or more times a week had holes or tears compared with 41% of those used less often. Filters used by more than one person also had more holes and tears (66%) than those used by only one (34%) but this difference was not statistically significant.

Closer observation is needed to determine what aspect of use leads to filter damage. For example, it was observed that the lips or rims of some clay pots were rough, and that twigs and other debris in pond water contained sharp objects. The washing process after use might also have contributed, depending on how people scrubbed or rinsed water out of the cloth.

5.4 Impact of MPG Filter on Disease Prevalence

The prevalence rate of guineaworm in Idere and farm hamlets was about 43% in the 1980/81 dry season at the time the baseline was conducted for the original research project. Due to control measures which were intensified, mainly wells and education to prevent contamination of water sources, the rate had dropped to about 27% in the 1984/85 dry season i.e., over a period of four years. The distribution of filters started in October, 1985 at the beginning of the dry season and lasted for six months until March 1986, the end of the dry season. By the following dry season (1986/87) the rate had dropped drastically from 27% to 8% on average, in the compounds and hamlets monitored for the filter project.

But other factors could have contributed negatively or positively to this drop in prevalence in the 1986/87 dry seasons. Such factors include: (i) the time the filter was purchased because those who purchased late in the dry season of 1985/86 or afterwards could have been infected prior to purchase and use of the filter; (ii) exposure of filter users to infection during visits to areas where they drink cyclops infested water and (iii) the degree of efficiency attained in filtering water by the user. However, there were notable differences between sectors in reduction of prevalence rates; prevalence of guineaworm in hamlets where there were active VHWs was 5% compared to 14% in the remaining hamlets where VHWs were not active or were absent. According to this trend, and barring technological problems of filter production and failure to use filters correctly and regularly, it is estimated that complete eradication of guineaworm with MPG filter could be attained over two transmission seasons by all at-risk families in all the sectors of Idere community.

6. LESSONS LEARNED AND IMPLICATIONS FOR SOCIAL AND ECONOMIC RESEARCH

6.1 Technological Adaptation for use in Disease Control: The Role of Social Sciences

The filter study demonstrated the importance of adapting technologies used in scientific investigation, in this case microbiology and entomology, to the practical needs of communities involved in disease control programmes. The study also showed the role that the social sciences have (in this case in the development of a social marketing strategy) in fostering an adaptation process so that the resulting product (a locally designed filter made from imported material) could gain wide acceptance among the target population. Cooperation among researchers, government agencies and the target communities is essential for the success of operations research. In this study, the Idere Primary Health Workers, the African Regional Health Education Centre, the Ibarapa Community Health Programme and the Department of Preventive and Social Medicine provided the organizational and intellectual social science infrastructures to develop and test the acceptance of an improved technology for disease control.

The main purpose for testing the filter in Idere was to determine whether this inexpensive and imported, but locally adapted, technology would be adopted as a reasonable alternative or addition to a larger mix of disease control strategies, through a better understanding of the social, political, psychological and economic characteristics of the users. The effect on prevalence should therefore be seen in this context and not as an isolated result of introducing monofilament nylon cloth filters.

While the filters were purchased by nearly one-third of the monitored population, thus raising the level of access to safe water to over half of Idere families within six months of promotion, important lessons were learned on the adoption of the improved and adapted technology.

6.1.1 The Problem of Habituation

The study indicated that the filter is a valuable control intervention in that it gives individuals and families an option for action where the larger community might not be ready or able to afford the cost of wells which provide permanent sources of safe water. But certain behavioural conditions must be met. Not only must there be a purchase of a filter, sustained and efficient use of the filter by families must become habitual in order to guarantee its effectiveness. Each family member in the endemic area must also remember to filter water every time he or she is thirsty. This implies that a set of new behaviours must be learned and routinely practiced several times everyday for a minimum of two years. Adopting these behaviours is not easy as water consumption practices are learned in the very early years of a person's life and these ingrained habits will not change quickly. The alternative filtering behaviours are not as easy to practise as the former custom of drinking water without daily filtering rituals. From the perspective of behaviour change, in terms of learning the steps and precautions required for effective use of filters, as well as frequency and intensiveness of practice, we can conclude that the coverage and impact on disease achieved in the present study was good, at least in the short term.

6.1.2 Perceived Benefits of Alternatives

Another behavioural issue that had to be examined was community perception of the observable benefits of the alternative personal protection measures. For example, alum is widely used in Idere and it costs less than US 2 cents to treat a pot of water. The reported benefit of alum (speedy clearing of dirt from water) was believed by a number of people to be adequate for making water safe for drinking. Just as obtaining clear water from wells was a reasonable option for others, simply fetching water from a pond and allowing it to settle was acceptable to some, because it had no financial implications. The existence of these alternatives were bound to affect the rate of filter acceptance by community members who saw the filter as only one means of removing dirt from water.

6.1.3 Attitudinal Factors Related to Failure of Past Interventions

The University had provided the village of Tobalogbo with a demonstration well some 15 years prior to the study and the well had gone dry. During sales promotion at Tobalogbo elders told the research staff and medical students that they wanted wells, not filters. A similar situation had inhibited community action for water supply (wells) in the main town of Idere for many years. Government had provided tap water in Idere years back and guineaworm was virtually eradicated. But guineaworm had resurfaced after the taps went dry and people had to return to the abandoned cyclop-infested ponds. Idere people initially resisted all efforts to encourage them to dig wells because they insisted that the Government should restore pipe-borne water. Although they could not be quantified, these factors could have affected the rate of adoption of filters in the study area. People may have been reluctant to accept, and indeed may have resented, the new technologies because the previous ones had failed.

6.2 Social Marketing as a Health Education Strategy

Different health education strategies are needed to complement technical interventions in guineaworm control. Community organisation/development could be used to generate interest and mobilize the resources of people to develop and maintain a safe community water supply. Intensive social support strategies would also be required to keep infected persons from contaminating the new water sources. In contrast to community efforts for improved water supply, technologies that are based primarily on individual action, such as water filtration, may be promoted through broadly defined communication strategies that promote the diffusion of a new idea throughout the target population. This has of late become known as social marketing. A common denomination of all health education strategies should be a high level of community involvement.

Some of the key errors learned concerning the social marketing of a new technology, as a result of this study, are as follows:

6.2.1 Appropriate Technologies Enhance the Credibility of Health Workers who Promote Them

In this study it was found that VHWs saw the filters as enabling them to fulfil the roles for which they had been trained. Even VHWs who had not been active before came forward to participate when they had heard about the filter. Filters provided tangible evidence of the VHWs' value to the community. Other tangible evidence of the VHWs' effectiveness such as revolving drug funds or mobilization for a village well had been difficult to demonstrate in some villages because of economic constraints or lack of social cohesion. VHWs in such villages had become despondent and the filters provided them an opportunity to demonstrate their worth without significant financial outlay by the VHW or the community.

The VHWs were obviously more committed to sales than other volunteers. The driving force was not just the small profit margin but the pride that they had something (a solution) to offer to every individual. This provided them the opportunity to legitimize their role as health workers to whom community members had been looking to provide solutions to the health problems in the area.

6.2.2 Disease Control Technology should respond to both disease and human characteristics

It is now well know that interventions have usually been based on disease characteristics to the neglect of human needs. In the present case the rural villages could not afford more long-lasting, but expensive, solutions to the guineaworm problem. The filter, being cheaper and effective, was therefore both entomologically and economically appropriate to this population.

6.2.3 A Single Technology May Not Be Enough

The fact that a combination of wells and filters still did not cover the entire population means that other technologies and health education strategies will be needed in order for all segments of the population to be protected from guineaworm.

Any health technology will have its own natural barriers to acceptance and use. Alternative technologies should be available in order to devise a truly comprehensive control programme. Village X may have the economic resources and

social organization to come together and dig a well; village Y may be less well-off financially but may still have sufficient community spirit to buy temephos (an inexpensive insecticide) and to train one or two residents to apply it to kill cyclops. Families in nearby village Z may be more individually-oriented and prefer to buy filters. Future research should have the resources to study a multi-strategy approach in order to discover under what circumstances a control technology, or combination of technologies will be most effective and acceptable to target populations with particular social, cultural and economic characteristics.

6.2.4 Logistic Support is a "Sine qua non" of Technological Acceptance

Although it could have been due to the poor geographical location, the frustration experienced by people in the Oke Ofiki sector needs further examination. The problem was not just one unique to the filter project. Its most important roots were in the inadequacy of the overall primary health care programme organized in Idere. Although it had been possible in the dry season to gain easy access to the Oke Ofiki area and train the VHWs, follow-up supervision in the rainy season had been difficult. The Oke Ofiki area also had the lowest representation within the active members of the VHWs association. The issue in such an isolated area was therefore more of lack of logistic support than strategy. While the research assistant filled some of the gap, he was not so effective as resident VHWs could have been judging from the Tobalogbo results.

6.2.5 Predicting Sales from a Baseline Market Survey Could be Risky

Even though people were shown a prototype filter during the baseline marketing they were unable to fully comprehend its use or value. In many such surveys people tend to respond positively regardless of their true feelings, especially when they know that the interviewers were asking questions on a health problem that has no effective solution. A closer examination of purchases showed that they were made mostly by respondents who said they would be willing to pay the median price of #2.00 (35%). This in fact turned out to be the average cost of the three sizes of filters - #1.95 when profit was included. Those 40% who could not name a price below #2.00 could have been indicating real financial problems while those who stated high prices i.e. #5.00 - #10 could have been responding positively to please the interviewers.

The introduction of a disease control technology should take into account the proportion of the population that will not be able to afford the cost, as well as those who, although they could pay for it, would reject it for other reasons other than cost. Ability to pay is therefore not a sufficient indicator of sales potential.

Another important finding is that once a value has been internalized by people they will always be willing to invest on the bases of these values. Community members who had not reported previous cases of guineaworm in their families and those who had wells in their compounds were also the earliest purchasers of filters. While it is possible that they could have been more economically well-off than the late adopters, this factor is unlikely to be significant since the cost of the filter was deliberately subsidized to assure affordability by the majority of family members.

6.2.5 General Marketing Rules Apply Equally to Social Marketing of a Health Product

In marketing promoters of a product should ensure a constant supply of a product that has become popular and sustained promotional activities such as

publicity, and offer post-sales services to customers. It was found that after six months many filters had been torn and needed repairs or replacement. As these were not forthcoming such consumers relapsed and it was estimated that 66% of filter owners were unprotected after 6 months of usage.

6.3 Methodological Issues

Several important methodological issues arose from the study:

6.3.1 The Importance of Basic Infrastructure and the Need for Collaboration with Existing Programmes

The extent of sales hinged on the commitment to guineaworm prevention exhibited by the VHWs. The selection, training, organisation and supervision of the VHWs was an arduous task that took many years and a major infusion of TDR research funds prior to the filter study. Areas with no VHWs served as internal controls and it was shown that the presence of a recognized health worker who can provide ready support and services on matters concerning new technologies such as filters was essential for the programme's success. Even the intensive work of the field assistant could not substitute for a committed resident VHW. Without an understanding of the extent of the preparatory activities of this project, one could easily underestimate the amount and type of work needed for promoting the purchase and use of filters.

6.3.2 Balancing Scientific Objectivity and Commitment to Programme Success

The monitoring and evaluation process was more than mere observations and interviews. The VHWs the medical students and the field assistants played important roles in reinforcing the new behaviours of filter use and safe water consumption. As noted, these new behaviours are complicated because of required frequency of practices and special skills to be learnt. During the monitoring period the project staff was able to maintain a consistent level of correct filter use which might naturally have dropped off without the monthly reminders. In fact the contribution of this input was demonstrated when regular monitoring ceased.

6.3.3 Operations Research Requires Flexibility in Selection of Intervention Strategies

Different intervention strategies which were not predetermined evolved in different sectors as the programme progressed. For example, a contrast was seen between the two farm sectors. While the VHWs were the main salesforce in the Tobalogbo area the research assistant served as itinerant salespersons on the other side of the river. Without such flexibility that allowed the use of research assistants in place of VHWs, an isolated hard-to-reach area would have been left out in the provision of health services. In the case of guineaworm, such neglected areas could turn out to be reservoirs of infection that will later threaten the protected community. As we have seen, this was the case in Idere when taps went dry. The filter study therefore shows that different methodological approaches can be justified for the same type of research design even within the same target population.

6.3.4 Keeping to a Predetermined Timetable Could Reduce Maximum Benefits

A major concern was how to keep to the study's timetable. The intervention phase was delayed for almost one year because of the delay in receiving the filter cloths from abroad. This no doubt must have affected the quality and outcome of the research because baseline data could have been

obsolete and the morale of the researchers and community lowered as a result of the waiting and uncertainty. While one could not have expected much more coverage in the available time, given the limitations of funds, it became obvious that it would have been desirable to extend filter sales to a second season to see whether current owners would have bought new filters to replace damaged ones. This extension, if carried out, would also have had implications for epidemiological outcomes in the future. Thus, a two-year project would have been more appropriate. Not only would this have allowed for further exploration into adoption and use behaviours; it would also have allowed a study of factors that are predisposed to damaging and tearing of filters. This ultimately could have led to the production of a more refined filter technology.

6.3.5 Community Involvement is a Useful but Slow Process

The study shows how local filter production and potential skills transfer could be achieved. The VHWs and their people developed the feeling that they could do something about a perennial problem even under a state of economic distress. This increased their feeling of self-efficacy and esteem. But it was also shown that community involvement in the research process also means that plans will never go exactly according to the designs of the 'experts.' For example, the issue of pricing was decided by the VHWs, eliminating the possibility that the research staff could test the effects of differential pricing by different sales people. Ultimately what this demonstrated is that the VHWs felt a sense of ownership of the project, being involved in important decisions from the beginning, but the process took a longer time than was planned for. The pay-off is the likelihood that similar projects will be well received in the future, and the foundation has been laid for the promotion of other technologies in the context of a primary health care approach in the community.

CHART 1

TIME FRAME FOR GUINEAWORM FILTER PROJECT

Activity	Time	Dates
Baseline survey: consumer opinion, pot sizes	2 mos	Aug - Sept 1984
Prototype filter testing	1 mo	July 1985
Production/promotion planning with PHWs	2 mos	Aug-Sept 1985
Filter manufacture by Idere tailors	1 mo	Mid Sept-Mid Oct
Recruitment and training of sales people	1 mo	Oct 1985
Community level promotional activities	2 mos	Oct-Nov 1985
Distribution, sales and individual promotion	6 mos	Oct 1985-Mar 86
Monitoring adoption and use	5 mos	Nov 1985-Mar 86
Accounting and evaluation with PHWs	3 mos	Feb-April 1986
Project assessment and data analysis	3 mos	April-June
Total time expended on project	14 mos	

CHART 2

STEPS FOR SAFE AND EFFECTIVE FILTER USE

1. Always place the filter snugly on the pot with the BLACK thread facing upwards.

2. Allow the filter to sag in the middle so water will not splash.

3. Pour water slowly also to prevent splashing.

4. Let all water drain through the filter before removing.

5. Remove the filter carefully so that no debris (and cyclops) from the top side will flip into the pot.

6. Shake the filter out after using.

7. Wash it with clean water.

8. Hang it outside to dry in the sun.

9. Store it in a safe place away from sharp objects, preferable in a small nylon bay.

10. Inspect the filter before each use to detect any holes and tears; a town filter should not be used.

FIGURE 1 SKETCH MAP OF IDERE COMMUNITY

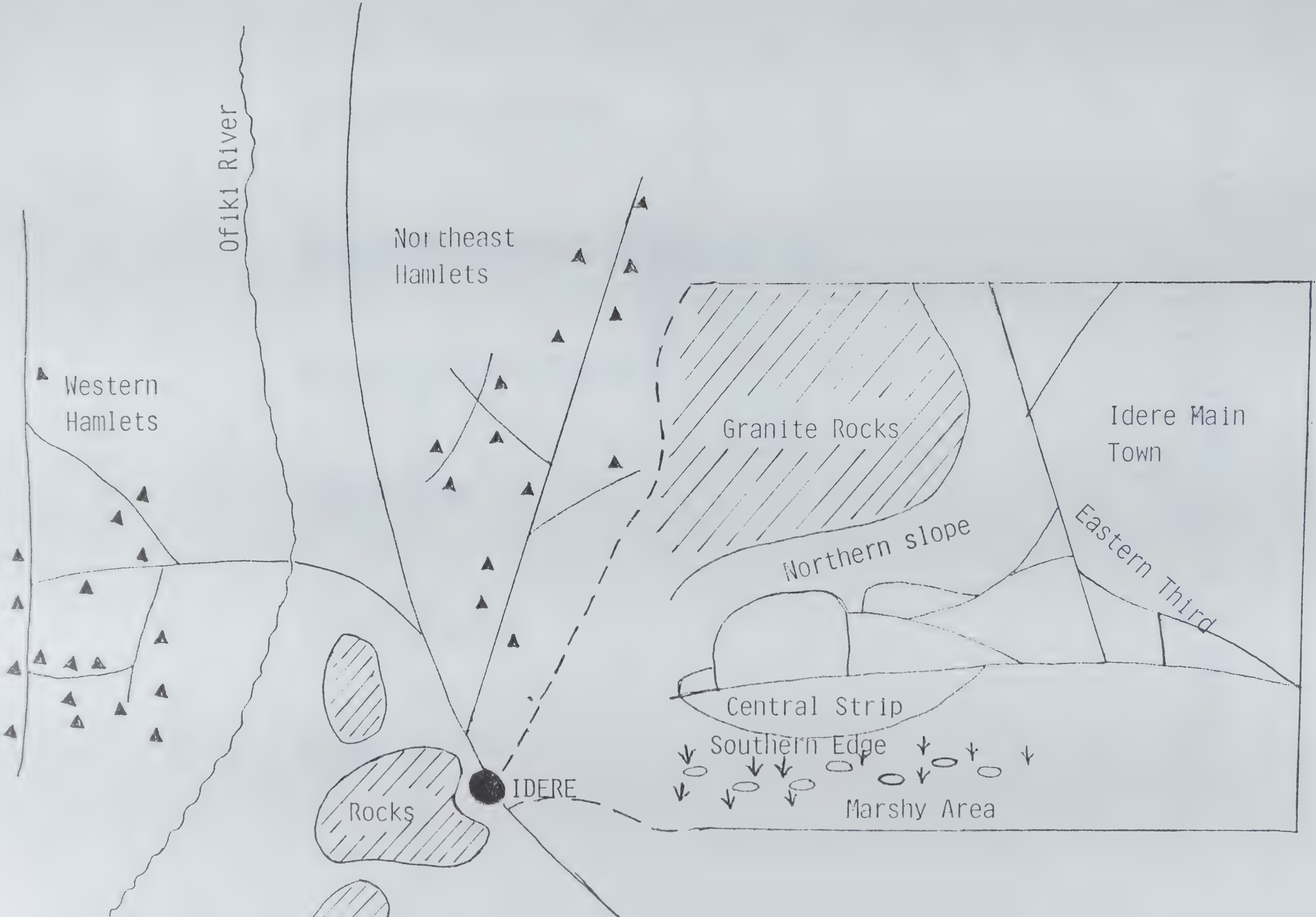
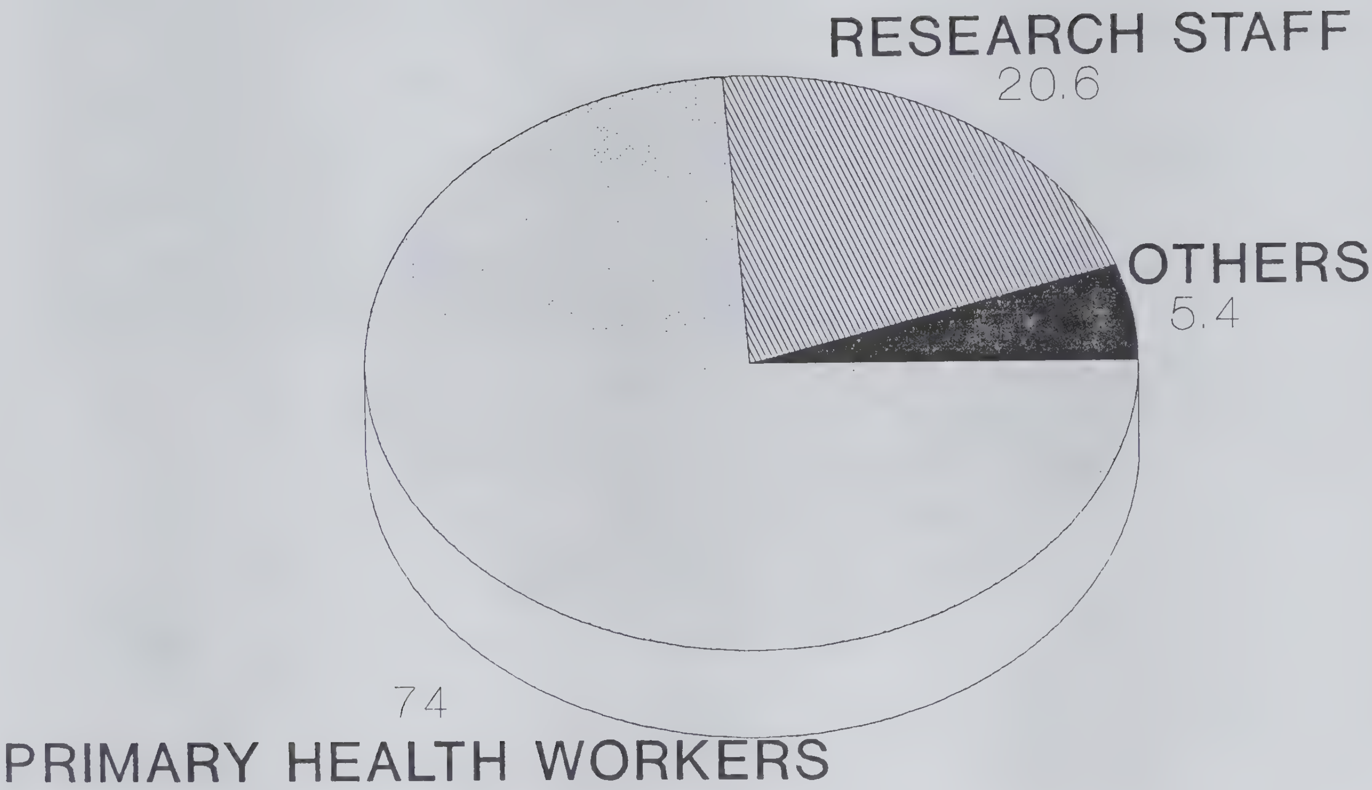
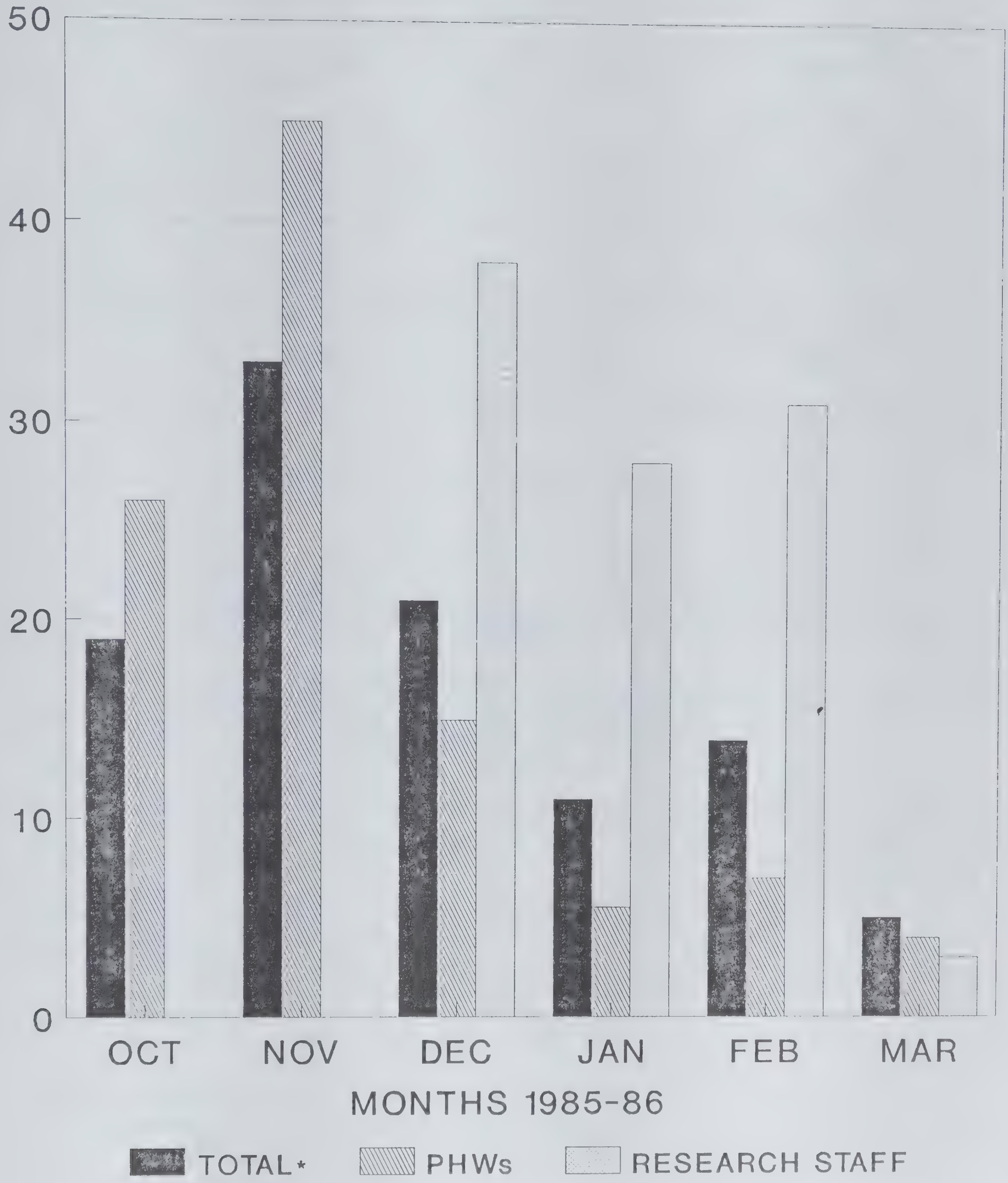


FIGURE 2: DISTRIBUTION OF SALES BY SALES AGENTS



N = 407

FIGURE 3 : Monthly Sales by Salespeople



* includes 4 sold by others

TABLE 1

AWARENESS OF FILTERING WATER BY PRESENCE OF PHW IN VILLAGE (Percentage Distributions)

Heard of Filtering	PHW Present			
	Yes	No	Total	
			%	No
Yes	64	26	56	139
No	36	74	44	111
Total	100	100	100	250

$X^2 = 24.57$ d.f. = 1 $p<0.0005$

TABLE 2

REPORTED PRACTICE OF CONVENTIONAL FILTERING BY PRESENCE OF PHW IN VILLAGE (Percentage Distributions)

Reported Practice	PHW Present			
	Yes	No	Total	
			%	No
Yes	12	0	10	24
No	88	100	90	226
Total	100	100	100	250

$X^2 = 7.315$ d.f. = 1 $p<0.01$

TABLE 3

HOUSEHOLDS WITH FILTERS
BY SECTOR MONITORED
(Percentage Distributions)

Possession of Filter	Sector: Tobalogbo	Oke Ofiki	Town	Total %	Total No
Yes	(57)	(36)	(20)	33	254
No	(43)	(64)	(80)	64	525
Total	158	230	391	779	

$X^2 = 69.077$ d.f. = 2 $p<0.0005$

TABLE 4

SIZES OF FILTERS SOLD IN VARIOUS SECTORS
(Numbers)

Monitored Areas	Sizes: Large	Medium	Small	Total
Tobalogbo	50	37	5	92
Oke Ofiki	46	37	3	86
Idere Town	32	37	12	81
Total in monitored Areas	128	111	20	259
Total reported by Salespeople	174	175	58	407

TABLE 5

SEX OF BUYER BY TYPE OF SALESPERSON
(Percentation Distributions)

Buyer	Salesperson				
	Primary Health Worker	Research Staff	Other	Total	
				%	No.
Husband	78	67	50.0	75	190
Wife	22	33	50.0	25	64
Total	100	100	100	100	254

X^2 (using PHW vs Research Staff only) = 3.50 d.f = 1 $p<0.10$

TABLE 6

SEX OF BUYER BY SECTOR
(Percentage Distributions)

Buyer	Sector				
	Tobalogbo	Oke Ofiki	Town	Total	
				%	No.
Husband	94	75	53	75	190
Wife	6	25	47	25	64
Total	100	100	100	100	254

X^2 = 38.690 d.f = 2 $p<0.0005$

TABLE 7

FAMILY HISTORY OF GUINEAWORM BY FILTER PURCHASE
(Percentage Distributions)

Filter Purchase	Guineaworm History in Past Two Years			
	Yes	No	Total	
			%	No.
Yes	26	36	33	254
No.	74	64	67	525
Total	100	100	100	779

$X^2 = 7.55$ d.f = 1 $p<0.01$

TABLE 8

ACCESS TO WELL BY PURCHASE OF FILTER IN TOWN
(Percentage Distributions)

Filter Purchase	Access to Well			
	Yes	No	Total	
			%	No.
Yes	28	7	21	81
No.	72	93	79	310
Total	100	100	100	391

$X^2 = 22.56$ d.f = 1 $p<0.0005$

TABLE 9

ACCESS TO WELL BY PURCHASE OF FILTER IN VILLAGES
(Percentage Distributions)

Filter Purchase	Access to Well			
	Yes	No	Total	
			%	No.
Yes	83	42	45	173
No.	17	58	55	215
Total	100	100	100	388

$X^2 = 15.55$ d.f = 1 $p<0.0005$

TABLE 10

SOURCE OF INFORMATION ABOUT FILTER BY PURCHASE
(Percentage Distributions)

Filter Purchase	Filter Purchase			
	Yes	No	Total	
			%	No.
Primary Health Worker	44	56	100	398
Reasearch Staff	33	67	100	171
Other Seller	25	75	100	47
Church	13	87	100	76
Mosque	0	100	100	10
Never Heard	0	100	100	37

TABLE 11

KNOWLEDGE OF CORRECT FILTER USE ON FIRST INTERVIEW
BY TYPE OF INITIAL EDUCATION (Percentages)

Points Remembered	Initial Education by Salesperson		
	Explanation only	Explanation and Demonstration	Total
Black thread faces upward	100	99	99
Sag in middle	27	54	54
Pour water slowly	82	97	96
Let all water go out	73	95	94
Remove carefully	84	75	74
Wash after use	91	99	98
Shake out after filter	82	96	94
Hang out to dry	82	93	93
Avoid sharp objects	36	34	34
Inspect before each use	18	29	29
Total Number*	11	238	249

*Total of 254 filters were bought in monitored areas, but four were purchased on last visit of field worker and one person received an explanation or demonstration when making purchase.

TABLE 12

COMMENTS ABOUT FILTERS FROM OWNERS/USERS COMPARED TO MONTH SINCE PURCHASED (Percentages)

Comments	Months Since Purchased				
	One	Two	Three	Four	Five
Removes Impurities	42	59	69	50	57
Fast	20	25	6	1	0
Removes leaves and insects	13	23	37	46	50
Easy to use	11	13	7	2	0
Good/healthy	19	7	4	2	0
Prevents drinking dirty water	3	2	6	6	5
Better than boiling	3	0	5	3	0
Useful	2	1	0	0	0
No comment	21	11	9	3	0
Total Number	150	110	98	114	42

TABLE 13

FILTER USE PROCEDURES: KNOWLEDGE AND PRACTICE
(Percentages)

Procedure		Percent Knowing/Doing Centre
Skills Demonstrated:		
Black thread faces upward		83
Sag in middle		80
Pour water slowly		98
Let all water go out		100
Remove carefully		70
Reported Practices		
<u>Wash filter</u>		100
With soap	72	
Rinse with filtered water	72	
<u>Frequency of Washing</u>		97
After each use	74	
Daily	9	
Twice a week	4	
Trice a week	6	
Less often	4	
Shake out and dry		96
Keep in safe place		43
<u>Inspect before use</u>		72
Check for dirt	51	
Check for holes	36	
Check for insects	23	
Total Number		54

TABLE 14

OBSERVED PROBLEMS OF FILTER (Numbers)

Problem	Number
Stained	46
Discoloured	34
Holes	31
Dirt/Dust/Soot	25
Lax band*	12
Tears	11
Frayed Edge	5
Stitching coming out	2
Total Number	54

* An additional 6 reported rubber band had gone lax but they were retightened.

TABLE 15

STORAGE METHOD COMPARED TO DAMAGE*
(Percentage Distributions)

	Storage		Total	
	In Plastic Bag	Pot, Basket, or open	%	No.
Tears and Holes	61	58	59	32
Intact	39	42	41	22
Total	100	100	100	54

* Only 9.4% of these owners recognized the damage

TABLE 16

FREQUENCY OF WEEKLY FILTER USE COMPARED TO DAMAGE
(Percentage Distributions)

	WEEKLY FREQUENCY OF USE*			
	1-3 Times	4 or more times	Total %	Total No.
Tears and Holes	41	80	59	32
Intact	59	20	41	22
Total	100	100	100	54

$X^2 = 8.295$ d.f. = 1 $p<0.005$

* Average: 4.2 times a week
Median: 3.5 times a week
Mode: 7 times a week (N = 16)
3 times a week (N = 12)

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